• COLORADO RIVER •

# AQUEDUCT NEWS

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

Vol. VI. FEBRUARY 25, 1939 No. 2

**THE COPPER BASIN RESERVOIR**

**First water poured into this basin through the portal of Copper Basin tunnel No. 2, extreme left, on January 29.**

• COLORADO RIVER •
AQUEDUCT NEWS
THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA
306 WEST THIRD ST.
LOS ANGELES, CALIFORNIA

*Published monthly in the interest of Field and Office Workers on the Colorado River Aqueduct, and for the information of all other citizens of the Metropolitan* **Water District**

Vol. VI February 25, 1939 No. 2

# First Water Pours Into Copper Basin On January 29

Moving up the second step of its 1600 foot climb over mountain ranges that lie between the Colorado River and the cities of The Metropolitan Water District, aqueduct water was started through the Gene pumping plant and into the Copper Basin reservoir on January 29.

Gushing out of the west portal of Copper Basin tunnel No. 2, high up on the side of the barren mountain wall that forms the one-time dry desert hole, the water created a spectacular white torrent as it cascaded down into the basin. Under the direction of Field Superintendent Tom Walsh and engineers from the Los Angeles office of the Electrical-Mechanical division, all three pumps in the Gene plant were operated at the same time so that the flow of water pouring into the reservoir amounted to 600 cubic feet per second, or approximately 270,000 gallons per minute.

Within a few hours after pumping was started, a sheet of water, impounded by the 210-ft.-high Copper Basin dam, had started to spread over the floor of the picturesque desert basin which has been a scenic landmark on the aqueduct line since the days of early surveys.

On February 24, reports received in the office of Chief Electrical Engineer J. M. Gaylord indicated that water was then 173 feet deep back of the Copper Basin dam, and that this newest Metropolitan Aqueduct reservoir then contained approximately 23,000 acre feet of water.

During the first few days that the plant was operated, the motors, pumps, valves, and other features of the pumping units were subjected to dozens of different electrical and mechanical tests,

(*Continued on Page* 12)

**Colorado River water flows out of the west portal of Copper Basin tunnel No. 2, and into the Copper Basin reservoir, at the rate of 270,000 gallons per minute as all three pumps go into action in the Gene pumping plant.**

## – DIRECTORY –

### BOARD OF DIRECTORS

W. P. Whitsett, Chairman
Franklin Thomas, Vice-Chairman
S. H. Finley, Secretary

Anaheim.....E. P. Hapgood
Beverly Hills.....Arthur Taylor
Burbank.....J. L. Norwood
Compton.....Warren W. Butler
Fullerton .....Walter Humphreys
Glendale .....Herman Nelson
Long Beach.....William M. Cook
Los Angeles.....Perry H. Greer
Los Angeles.....Otto J. Emme
Los Angeles..Louis S. Nordlinger
Los Angeles.....D. W. Pontius
Los Angeles.....John R. Richards
Los Angeles....Victor H. Rossetti
Los Angeles.....W. P. Whitsett
Pasadena .....Franklin Thomas
San Marino.....John H. Ramboz
Santa Ana.....S. H. Finley
Santa Monica.....Arthur P. Creel
Torrance.....Charles T. Rippy

J. M. Luney, Controller
Ira R. Pontius, Treasurer

### GENERAL STAFF

General Manager and Chief Engineer.....F. E. Weymouth
Asst. Chief Engineer.....Julian Hinds
General Counsel.....James H. Howard
Asst. General Counsel.....Arthur A. Weber
Chief Elec. Engineer.....J. M. Gaylord
Asst. to Gen. Mgr., Don J. Kinsey
Secy. to Gen. Mgr.....Elisabeth von Hagen

### DIVISION ENGINEERS

Distribution.....R. B. Diemer
Transmission....Robert N. Allen
Maintenance.....W. J. Neale
Field Supt. Pumping..T. T. Walsh

### SUPERINTENDENTS OF CONSTRUCTION PUMPING PLANTS

Intake and Gene.....T. T. Walsh
Iron Mt. .....B. H. Martin
Eagle Mt. and Hayfield.....G. E. Archibald

### SUPERINTENDENTS

**(Main Aqueduct Tunnels)**

San Jacinto Tunnel, District Force Acct., B. C. Leadbetter, Gen. Supt.; C. E. Sides, Tunnel Supt.; Edwin Noon, Supt.; F. A. Backman, Gen. Foreman.

**(Distribution Pipe Line)**

Schedules 21SC, 22SC, 23SC, J. F. Shea Co., Gilbert J. Shea, Gen. Mgr.; C. A. Shea, Jr., H. F. Rennebohm, Supts.

Schedules 24SC, 25SC, Emsco Derrick & Equipment Co.

Schedules 26SC, 27SC, 28C. Western Pipe and Steel Co.

Palos Verdes Reservoir, W. E. Hall Co.; Magnus Hjalmarson, Const. Supt.; L. W. Irwin, Const. Eng.

## History and First Annual Report Being Prepared

Covering all phases of progress in the construction of the Colorado River Aqueduct and Distribution System up to June 30, 1938, and including a review of the events leading up to the organization of the District in 1928 and an account of its activities since that time, a "History and First Annual Report of The Metropolitan Water District of Southern California" is now going to press, and is expected to be available for release in the near future.

Prepared under the direction of Charles A. Bissell, office engineer for the District, the history will contain approximately 350 pages of text and pictures describing the District and the Aqueduct. Cloth bound copies of the book will be sold for $1.00 each and paper covered volumes will be available for 50 cents each.

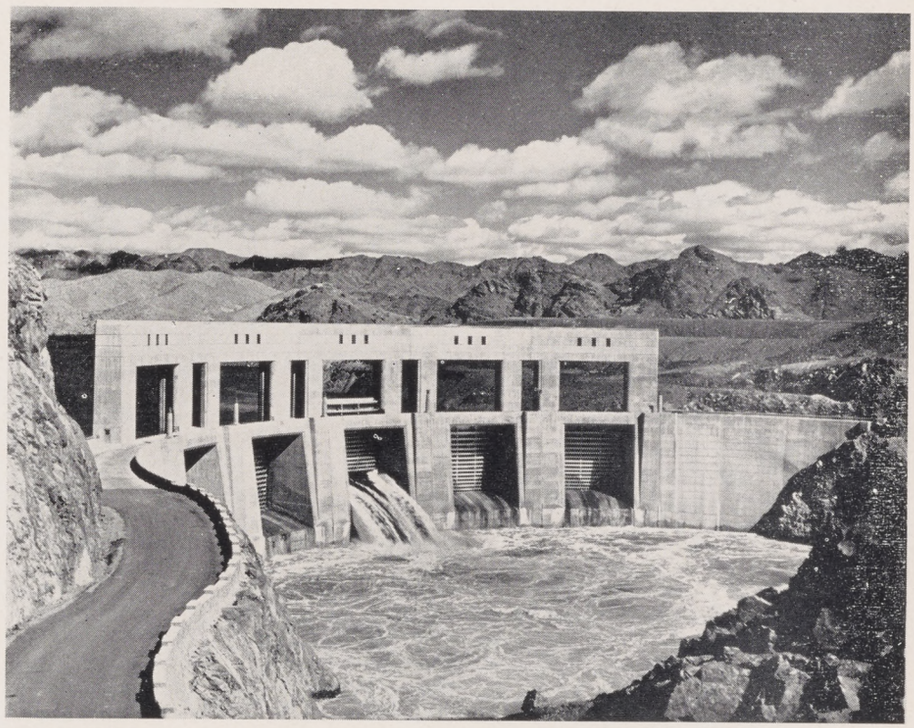
In its introduction, the history states:

"As is brought out in detail in the following pages, the phenomenal growth of population (in the metropolitan area) and industry in a naturally semidesert area has overtaxed the water resources appurtenant to the region to such an extent that for the coastal plain outside of Los Angeles the present deficiency of its permanent safe water supply is now computed at from 215 to 300 cubic feet per second, or from one-fourth to one-third of the dependable yield of the region's water resources.

"The need for a supplemental imported water supply was foreseen 15 years ago. The story of the problems solved and the obstacles overcome in the decade-long campaign which culminated in the construction of the Boulder Canyon project by the Federal Government and the authorization by the voters of the District of a $220,000,000 bond issue to build the Colorado River Aqueduct is an epic of enterprise of no less interest and importance to an understanding of the project as a whole than is the description of the construction of the works themselves.

"It has therefore appeared appropriate that this, the first annual report of The Metropolitan Water District of Southern California, should contain more than a passing reference to the history of the early investigations, negotiations, and legislative enactments accompanying the inception and development of the constructive project now nearing completion."

The History and First Annual Report contains 16 chapters which include: Need for Colorado River Aqueduct; Early development, enabling legislation, organization, power and water contracts; Surveys by the City of Los Angeles; Preliminary engineering work by the District; Location and design of the aqueduct; Financing; Main aqueduct tunnels; Canals, conduits, and siphons; Dams and reservoirs; Pumping plants; Distribution System; Specifications and contracts; Testing and inspection; Corporate organization, purposes, and powers of the District; and, Purchasing, Right of Way, Medical, Safety, Personnel, and Miscellaneous Activities.



**Twenty-five thousand cubic feet of water per second being released through the center gate of Parker Dam during recent calibration tests.**

## "Lake Havasu" Name Recommended

In an official communication to John C. Page, Commissioner of the Bureau of Reclamation, the Board of Directors of the District has suggested that the reservoir formed by Parker Dam be given the official designation of Lake Havasu.

Havasu is the Mojave Indian word for blue, and to many of the Mojave Indians now living along the Colorado River in the vicinity of Parker Dam the lake behind the structure is known as Lake Havasu, or "Lake of the Blue Water."

## Huge Flow Released At Parker Dam

In preparation for anticipated spring floods on the Colorado River, the U. S. Bureau of Reclamation began the releasing of approximately two million acre feet of water from behind Boulder Dam to make room for the flood waters in Lake Mead.

As the increased flow in the Colorado River reached Parker Dam it was necessary to raise the gates in that structure to allow 25,000 cubic feet of water per second to pass instead of the 6,000 second feet that normally flows over the lip of the spillway.

The huge volume of water, approximately 11 million gallons per minute, which roared through the gates in Parker Dam caused the river to be covered with white foam for a number of miles below the dam. Bureau of Reclamation engineers at Parker Dam took advantage of the increased flow to calibrate the gate openings, both individually and in combinations.

Release of excess water from Lake Mead is expected to be continued until March 1. Reclamation engineers have indicated that if the run-off of 1939 equals that of 1938, they may allow the water level back of Boulder Dam to rise high enough to test out the spillways at the giant structure.

# TUNNELS

**Problems involved and methods used in the construction of the 92.09 miles of tunnels on the main aqueduct.**

By J. L. BURKHOLDER
*Asst. Gen. Mgr., M. W. D.*
*1932-1938*

Twenty-nine tunnels varying in length from 338 to 96,605 ft. comprise the 92.09 mi. of tunnel on the main aqueduct. Of this total, contracts were awarded for 58.35 mi. and 33.74 mi. was scheduled for construction by District forces. The contractor on the 13.04-mi. San Jacinto tunnel, after having excavated 2.37 mi., was seriously behind his program and completion of this work was added to the district's force account program.

The district awarded contracts for the 58.35 mi. of tunnel to thirteen well-known contractors from various parts of the United States. With the exception of San Jacinto tunnel (holed through Nov. 19, 1938) all tunnels were completed by July, 1937, well in advance of schedule. Tunnel driving was carried on from 60 headings.

With the exception of the tertiary sediments, characteristic of the Whipple Mountain range near the Colorado River, which required very little support, all other formations penetrated required support varying from 25 to 100 per cent of the length. The granitic formations were found to be loosely jointed and to have a tendency to air slack when exposed. The metamorphic rocks were normally closely fractured and most of the "heavy ground" was encountered in these materials. The gravels and other alluvial materials required support throughout, but were usually coherent enough to permit excavating without spiling or breast-boarding.

Numerous dead faults were encountered with crushed zones varying from a few inches to several hundred feet wide. These zones usually required heavy support and enlargement of the section for extra heavy lining. In the dry tunnels it was unusual to find fault zones extremely difficult. In wet tunnels, however, notably the San Jacinto and the Valverde, water encountered in open seams and in crushed areas gave rise to difficulties that seriously impeded progress.

In driving 71.85 mi. of "dry" tunnels, the outstanding over-all average progress of 7.04 ft. per shift or 21.12 ft. per day was attained with maximum monthly advances as high as 1,101 ft. Plant units that were of material aid in attaining this excellent progress were: (1) well designed drill carriages, planned to facilitate full face driving; (2) improved mucking equipment, used in conjunction with large capacity cars and time saving switching devices; (3) automatic-feed drills with longer carriages (30 in.) requiring fewer changes of steel; (4) improved ventilating plants; and (5) the use of standby units to prevent loss of time due to equipment breakdowns.

Profiting chiefly from experience in constructing diversion tunnels at Boulder Dam, excavating plants were designed for the full face method of driving.

As an average, each round blasted out of the tunnel headings yielded an advance of 7.3 ft. The average shift per heading required for the various surface and underground operations connected with tunnel excavation numbered 27 men.

Typical drill carriages provided two decks from which the drillers, by use of swivelled arms and columns supported at the front end of the carriage, spaced and directed drill holes to conform to adopted blasting rounds. From five to eleven drills were thus mounted as required by the rock conditions to drill 25 to 80 holes. The pipe framework of the carriage was used for delivery of air and water to facilitate speedy connections to each drill. The old screw-feed type drills were not used; instead, automatic feed, and pneumatic drills were standard equipment because they gave the advantage of constant pressure on the bit, thus permitting maximum drilling speed.

Blasting was done with 40 to 60 per cent gelatin powder (using 1¼x12-in. cartridges in distinctive red wrappings) of which an average of 2.7 lb. per cu. yd. of solid rock was used. Some rock required as much as 7 lb. per cu. yd. The powder was detonated electrically from a 440-volt circuit used exclusively for this purpose.

Mucking machines of two types were used: the shovel type and the conveyor type. The latter greatly predominated, although there were five -¼-yd. crawler-mounted shovels which had been especially designed for this work.

Because mucking machine operation is so frequently interrupted by the switching of muck cars, tunnel men were continually trying to save time by improving the car switching devices. Many new ideas were tried out in the course of this work but the well-known California type switch was the most successful because of its simplicity.

Tunnel tracks built to 36-in. gage with 40-lb. rails were adopted as standard. Traffic protection was provided by automatic or hand-operated block signals at intersections and control points. Power units for haulage were 8-ton battery or trolley type electric locomotives. The all-metal side-dump cars, of either the Western or mine type, were used with capacities of 4 to 6 cu. yd. Excellent ventilation was maintained by surface-operated fans (arranged to exhaust or to blow) through 22-in. metal pipe.

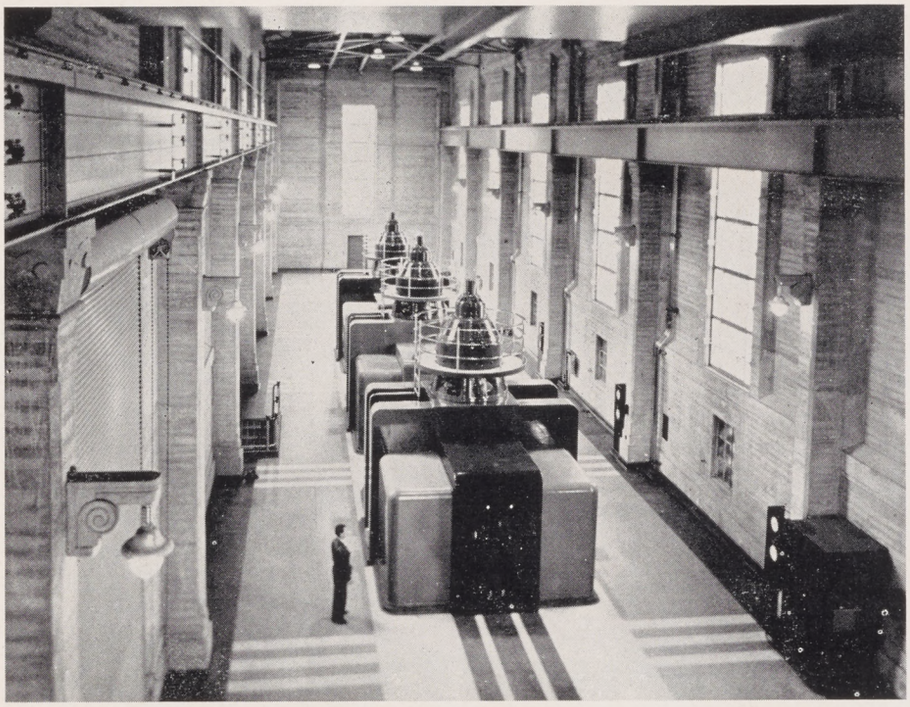
With 62 per cent of the tunnels requiring temporary support, three types were used to suit varying conditions: timber, metal-lagged steel and timber-lagged steel. Shotcrete was put on extensively to prevent air slacking and spalling of the rock; its early application to walls and arch often saved the cost of more expensive supports.

Timber supports were five- or seven-segment sets supported by plumb posts; wall plates were used to support arch segments only where bad ground made independent sets unsafe. Timber sizes were 10x10 in. and 12x12 in. for ordinary conditions, or 16x16 in. for heavy pressures.

The metal-lagged steel support consisted of arch ribs supported on wall beams and columns and lagged with pressed steel liner plates bolted to the ribs. In this combination costs were high for both material and labor. Early experiments made by the District led to development of an independent steel rib type of support which effected savings in time and cost. This support, which became standard for the job, consists of two-segment I-beam ribs rolled to proper shape and bolted together at the arch center. Steel rods and timber collar braces were used to bind the sets together.

In most of the tunnels concrete lining was placed by the continuous pour method, utilizing 200 ft. of telescoping steel arch forms, moved ahead in 20-ft. sections as the work advanced. Lining was begun at the point farthest removed from the tunnel access and was advanced toward that point. Concrete was pumped or shot through a single pipe and allowed to flow down the form until side slopes of about 3:1 had been built up and the initial section of the form was completely filled. By moving the discharge pipe laterally, concrete was distributed alternately in the side walls of the arch. The important operation of filling the crown was performed by directing the concrete so as to form nearly horizontal shoulders at the quarter points of the

(*Continued on Page* 8)



**An interior view of the Intake pumping plant showing the three 9,000 horse power motors which drive the pumps in this plant.**

## 110 Miles of Main Aqueduct Ready for Service

In preparation for the first aqueduct water which will flow by gravity out of the Copper Basin reservoir (see page 2), District maintenance crews under the supervision of Maintenance Engineer Walter Neale have been busy during recent week getting conduits, canals, and siphons ready for service.

Check dams, which impounded water for curing purposes, have been removed from the Eagle Mountain, Coxcomb, Iron Mountain, and Whipple tunnels, and rubber sealing strips have been installed on the wasteway gates at Coxcomb, Eagle Mountain, and Hayfield.

During January, accumulated sand and debris was removed from open canal sections, and check dams from conduits, in a total of 24 miles of the main aqueduct, and bulkheads were removed from tunnel portals and siphons for a total of 55 miles. The main aqueduct is now reported to be ready for operation between the Intake and Eagle Mountain pumping plants, a total of 110 aqueduct miles.

At the same time work has been in progress on the clearing of the Hayfield reservoir, and on February 20 the clearing of this basin was more than 50 per cent completed.

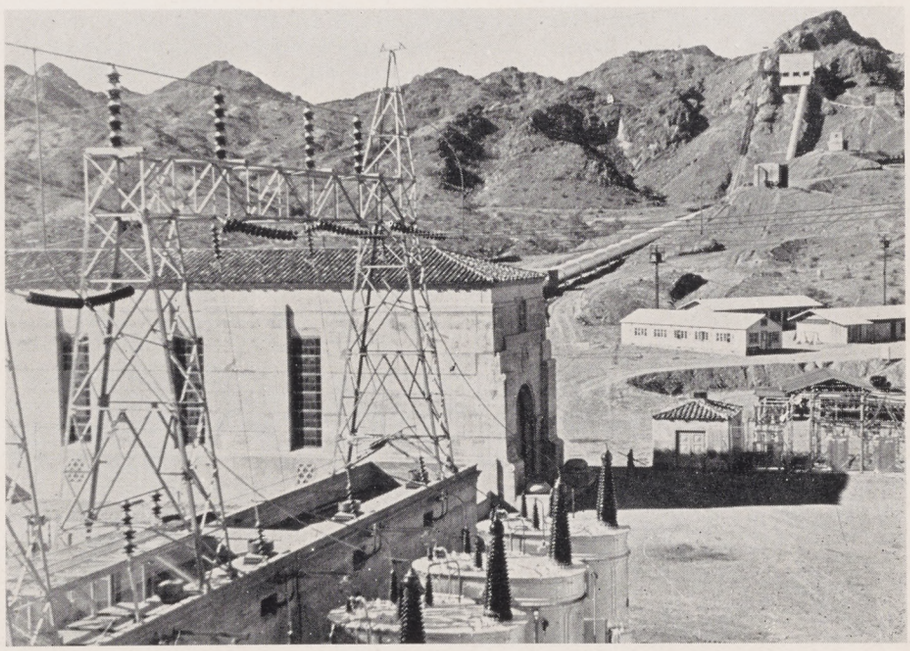
## District Officials Paid High Honors

Both General Manager Weymouth, and Board Chairman Whitsett have been paid high honors within the last few weeks for their services in connection with the building of the Colorado River Aqueduct.

During a recent visit in the east, where he was engaged on District business, General Manager Weymouth was officially made an Honorary Member of the American Society of Civil Engineers in recognition of his distinguished engineering career, particularly in connection with the construction of the aqueduct. There are only 25 living men who have achieved this high honor in the society, which is the oldest engineering group in America.

At a recent banquet of the Los Angeles Realty Board held in the Ambassador Hotel, W. P. Whitsett, Chairman of the Board of Directors of the District, was presented with a service watch given annually by the Realty Board to the Los Angeles citizen who has performed the most valuable and unselfish service for the community during the preceding year. In selecting the recipient of the service watch this year special recognition was given to Mr. Whitsett for his untiring efforts toward the successful completion of the Colorado River Aqueduct.

Mr. Whitsett was a Commissioner of Water and Power of the City of Los Angeles from 1924 to 1930, and has served as Chairman of the Board of Directors of The Metropolitan Water District since it was organized in 1928. In 1911 he founded the town of Van Nuys, where he makes his home, and which is now a part of the City of Los Angeles.



**An exterior view of the Gene pumping plant with the transformers in the immediate foreground and the delivery line in the background.**

# MONTHLY REPORT REVIEWS ACTIVITIES ALONG THE AQUEDUCT LINE

**(EDITOR'S NOTE: The following is a brief summary of some of the activities of the District as set forth in the monthly report of General Manager F. E. Weymouth, filed with the Board of Directors in February, covering work done in January.)**

### Legal Division

Financing—All necessary documents to secure the payment for Interim Certificate No. 90 in the denomination of $1,476,000, were prepared. Payment for said certificate was made January 28, 1939.

### Miscellaneous Activities Division

On January 2 the District entered a float in the 1939 Pasadena Tournament of Roses Parade. The float was titled "The Vision of the Golden Cities." It was awarded first prize in its class. On January 7 the first water from the Colorado River was delivered into Gene basin reservoir by Intake pumping plant. This milestone in the Colorado River Aqueduct project was marked by an official celebration attended by members of the Board of Directors, officers and employees of the District, and representative citizens and officials of the thirteen District cities. Delivery of the first water into the aqueduct was heralded throughout the United States by a coast-to-coast broadcast sponsored by Columbia Broadcasting System.

### Main Aqueduct

*Gene Reservoir*—Pumping into Gene reservoir was formally begun during the dedication ceremonies on January 7. It was filled to elevation 732.1, or 3.9 feet below the lip of the spillway, in 283 pump hours of operation.

*Copper Basin Reservoir*—The installation of electrical equipment and wiring at the sluceway in the dam at the outlet gate structure was completed. A barrier of boulders was placed across the canyon several hundred feet above the dam to prevent washing of debris into the sluceway during early stages of filling the reservoir. The first water was pumped into the basin through the Copper Basin tunnels on January 29, 1939.

*M. W. D. road from Earp to Parker Dam*—Except for roadside ditches, grading was completed for the relocation by the U. S. Indian Service of the river road opposite Headgate Rock dam site. Preparations are being made to place the oil mix surfacing. Poles have been set for relocation of the District telephone line along this portion of the road.

*San Jacinto tunnel lining*—The East Portal crew is nearing completion of all clean-up work and placing of curb and invert in the Cabazon section. Forms have been set near Lawrence adit in preparation for placing concrete arch easterly from that point. The Potrero crew was engaged in concreting the arch in a westerly direction around the curve at Lawrence adit. At the end of the month 7.16 miles of concrete arch and 12.74 miles of concrete invert had been placed. Only 1,553 feet of invert remained to be placed near Cabazon adit.

### Civil Engineering Division

*Design*—The major activity of the Design Division continued to be the preparation of plans an dspecifications for a water treatment plant for the upper feeder of the distribution system. The specifications for alternative designs of mechanical equipment for mixers and settling basins were practically completed. Specifications were issued for purchase of metering equipment for the connection from the Palos Verdes feeder to the Ascot reservoir, and work was in progress on plans and specifications for similar equipment for the Compton, Torrance, and Long Beach laterals.

### Distribution Division

*Field Work*—One or two parties were engaged for practically the entire month on cross-section and other survey work at the Palos Verdes reservoir site preparatory to beginning construction operations. Surveys were made along alternative locations for the Glendale-Burbank feeder.

### Electrical Engineering Division

As noted above, both the Intake and the Gene pumping plants were placed in preliminary operation during the month of January. Tests were carried on at these two plants during the month and work was continued on the installation of equipment at the Iron Mountain, Eagle Mountain, and Hayfield plants.

### Purchasing Division

A total of 911 purchase orders was issued, covering purchases amounting to approximately $75,000. Carload forwardings for the period totaled 303.

### Accounting and Costkeeping

The total cost of the work accomplished to January 31, 1939, was $174,773,129.

# Two Contracts Completed on Distribution Work

Completion of the construction of all links in the Distribution System Upper Feeder from the Cajalco Reservoir to the west portal of San Rafael tunnel No. 2 was announced when Distribution Engineer R. B. Diemer reported the end of work on the headworks structure on February 7, and the filing of the notice of completion on the San Gabriel, Monrovia, and Eagle Rock canyon crossings on February 14.

The headworks structure, which is located at the north portal of the Cajalco outlet tunnel, will regulate and control all water flowing into the distribution system. It was built by the Contracting Engineers Company, and Julian Huddleston was superintendent for the contractor on the work.

The three canyon crossings, which are of monolithic reinforced concrete construction, were built by Basich Brothers, with Nick Basich as general superintendent. These crossing structures connect Monrovia tunnels Nos. 1 and 3 across San Gabriel Canyon, Monrovia tunnels Nos. 3 and 4 across Monrovia Canyon, and San Rafael tunnels Nos. 1 and 2 across Eagle Rock Canyon. The connection for the Palos Verdes feeder is also made with the Eagle Rock Canyon crossing structure.

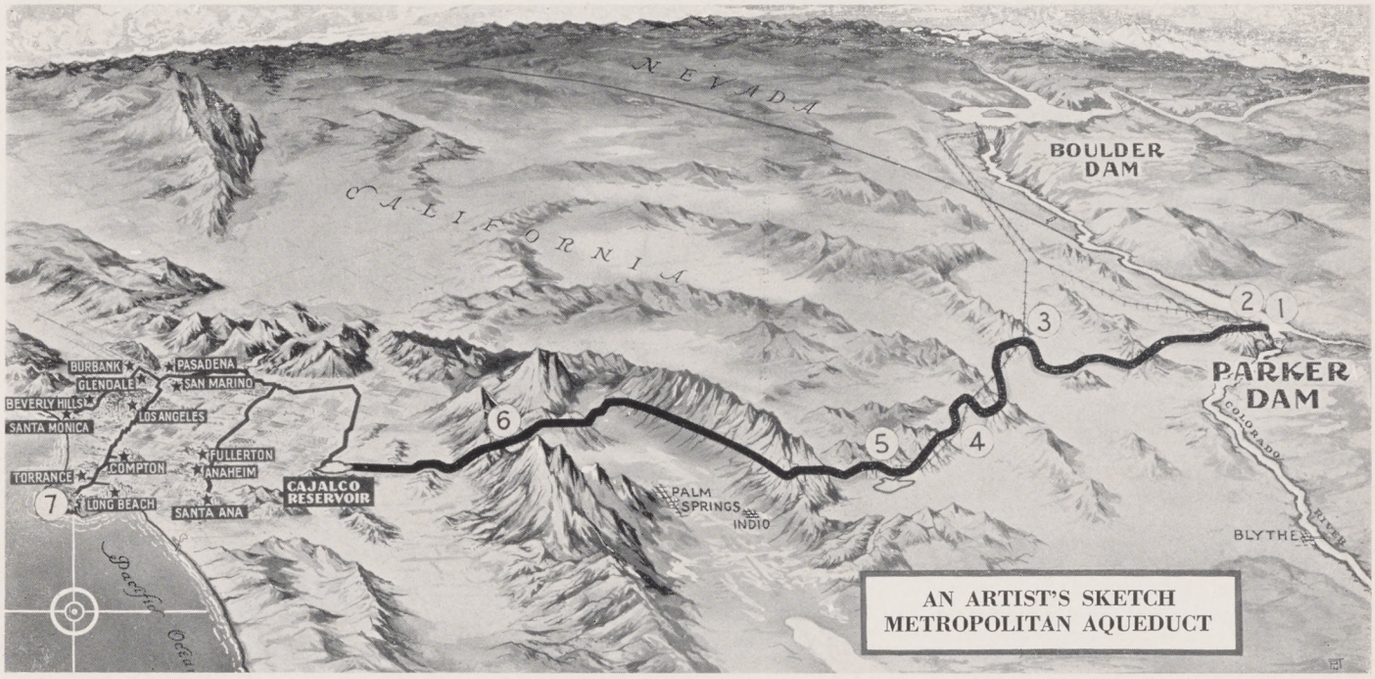
Meanwhile work is rapidly nearing completion on the upper end of the Palos Verdes feeder where crews of the J. F. Shea Co. are constructing schedules 21SC, 22SC, and 23SC. These pipe line schedules consist of welded steel pipe with a spun mortar lining and coated on the outside with gunite.

The welding of the steel pipe on Schedule 22SC was completed on January 23, and clean-up operations preparatory to testing were in progress at the end of the month, and portions of Schedule 23SC have been completed and are being tested.

The W. E. Hall Co. started construction of the Palos Verdes reservoir in January, and at the present time is employing a number of large tractors and carryalls in moving dirt for this job.

### SAFETY AWARD

**The lost-time accident frequency record for the San Jacinto tunnel work for the month of January was 74 as compared with 125 in December, and with 145 for the year 1938. Potrero forces were awarded the safety flag for the lowest lost-time accident frequency record during January.**




**Numbers on the above sketch indicate locations of aqueduct construction work underway on February 25, 1939. From right to left: (1) Intake, (2) Gene, (3) Iron Mt., (4) Eagle Mt., and (5) Hayfield pumping plants—installation and testing of equipment; (6) San Jacinto tunnel—concrete lining; (7) Palos Verdes feeder of distribution system—construction being completed on upper end of this feeder (Eagle Rock Canyon to 98th St. in Los Angeles) and underway on main feeder south of 98th St., laterals to Compton, Torrance, and Long Beach, and Palos Verdes reservoir. Except at points noted, main aqueduct from Intake to Cajalco reservoir, and upper feeder of distribution system (Cajalco to city limits of Glendale), is now completed.**

# 1939 Expenditures Estimated At $15,000,000

Estimates prepared under the direction of General Manager Weymouth indicate that the District will spend approximately $15,000,000 for construction purposes during 1939.

Of this total, $2,500,000 represents the estimated cost of completing the pumping plants, San Jacinto tunnel, and the short siphon at the west portal of that tunnel, on the main aqueduct. The estimated cost for carrying forward present pipe line construction on the distribution system is $2,000,000, and an additional $10,500,000 will be spent for pipe line, reservoir, and other distribution system construction.

The total cost of all work done to January 31, 1939, was $174,773,129. This includes the cost of work done by the city of Los Angeles prior to the formation of the District, and the cost of Morris Dam built by the city of Pasadena. Based on the work necessary for initial delivery of water to the 13 cities in the District, the project is now more than 92 per cent completed.

## MAJOR AQUEDUCT WORK NOW UNDER CONSTRUCTION

*Tunnels—Main Aqueduct*

| *Project* | *Length in Miles* | *Contractor* | *Awarded* | *% Compl.* |
|---|---|---|---|---|
| San Jacinto | 13.04 | Metro. Water District | 2-10-33 | 95 |
| (Started by Wenzel & Henoch Construction Company. Work taken over by District on February 12, 1935.) | | | | |
| Sch. 20 A and B—Siphon | 0.14 | Metro. Water District | 12-7-34 | 39 |
| (Siphon at West Portal of San Jacinto Tunnel. Original contract awarded to Griffith Co.; remainder of work to be done by District forces.) | | | | |

*Pumping Plants—Installation of Equipment*

| | *Contractor* | *% Compl.* |
|---|---|---|
| Intake | Metro. Water District | 99 |
| Gene | Metro. Water District | 99 |
| Iron Mountain | Metro. Water District | 99 |
| Eagle Mountain | Metro. Water District | 97 |
| Hayfield | Metro. Water District | 87 |

*Open Work—Distribution System*

| | | | | |
|---|---|---|---|---|
| Gunite-coated welded steel pipe with spun mortar lining: | | | | |
| Sch. 21-SC | 5.48 | J. F. Shea Co., Inc. | 9-10-37 | 99 |
| Sch. 22-SC | 5.36 | J. F. Shea Co., Inc. | 9-10-37 | 99 |
| Sch. 23-SC | 6.53 | J. F. Shea Co., Inc. | 9-10-37 | 99 |
| Sch. 24-SC | 6.81 | Emsco Derrick Equip. Co. | 10-14-38 | 1 |
| Sch. 25-SC | 6.70 | Emsco Derrick Equip. Co. | 10-14-38 | 1 |
| Gunite-coated welded steel pipe with spun mortar lining: | | | | |
| Sch. 26-SC | 4.71 | Western Pipe & Steel Co. | 12-30-38 | 1 |
| Sch. 27-SC | 1.23 | Western Pipe & Steel Co. | 12-30-38 | 1 |
| Sch. 28-SC | 1.33 | Western Pipe & Steel Co. | 12-30-38 | 1 |

*Reservoir*

| | | | |
|---|---|---|---|
| Palos Verdes | W. E. Hall Co. | 12-30-38 | |

# CANALS

**Methods used in the construction of the 62.8 miles of concrete lined canals on the Colorado River Aqueduct.**

By G. E. ARCHIBALD
*Supt. of Const., Eagle Mt. and Hayfield Pumping Plants, M. W. D.*

**(Ed. Note: During the heavy construction period on the main aqueduct Mr. Archibald was employed as an engineer on the Div. I headquarters staff.)**

Canal is the oldest and simplest form of man-made waterway, and its construction might well be expected to excite little interest. The construction of 62.8 miles of concrete lined canal for the Colorado River Aqueduct, however, attracted widespread attention because of bold design of special machines, which permitted placing of the canal lining at a rate from two to three times as fast as by any former methods, and with better results.

Metropolitan Aqueduct lined canal in earth has a finished bottom width of 20 feet, a top width of 55.13 feet and a depth of 11.71 feet. In general, the canal was not set in the ground to this full depth, part of the excavated material being used to build an embankment on each side to form the upper part of the canal, similar to familiar irrigation practice. A portion of the excavated material also went to form a dike on the uphill side to protect the canal from storm water. A roadway was constructed on the other side. Where the aqueduct crosses washes which are a part of the natural drainage of the country, canal is replaced by closed conduits known as "siphons" which are constructed below the beds of the washes and do not obstruct the run-off of storm water.

The five firms awarded contracts which included canal construction were: Barrett & Hilp and Macco Corp.; Jahn and Bressi Construction Co.; Wood and Bevanda; Utah Construction Co. and Aqueduct Construction Co. The first canal lining was placed by Wood and Bevanda in January, 1935, and the last by Aqueduct Construction Co. in March, 1937. Activity was at its height on all contracts during the winter of 1935-36, when a practically unbroken line of construction equipment extended from Coxcomb Mountain to Vidal, and ribbons of concrete crept across the desert as though by magic.

Rough excavation for canal offered no new problems and was particularly suited to the dragline type of excavator. Machines of sizes in common use predominated with 1¾ and 2 cubic yard buckets and powered with gas or diesel engines. Usually two of these machines were operated in echelon, each digging one-half of the trench as they progressed. On each of two of the contracts, however, the bulk of excavation was accomplished by a single electrically driven machine of larger size with 5 cubic yard bucket. Power was transmitted to this machine through 1,000 to 1,500 feet of armored cable from a substation mounted on a trailer and connected directly to the District's 33,000-volt transmission line along the aqueduct right of way. Excavation by dragline was made as close as possible to finished lines since trimming must be done by more expensive methods. A grade man equipped with hand level and rod kept constant check on this condition.

The chief problems confronting the contractor were those of trimming the earth slopes and placing the 6-inch to 8-inch concrete lining accurately to designed lines, and at the same time rapidly and economically. Road grading and paving types of equipment could be used for the bottom of the canal but not for the side slopes. Hand methods were sure, but slow and costly. On the other hand, attempts at mechanization meant fairly heavy expenditures for special equipment without certainty of success. As it happened, most of the experiments that were unsuccessful failed because of compromise in design due to efforts to avoid heavy first costs.

Machines were designed, however, which were successful from the outset. The first trimming machine, pioneered by Wood and Bevanda, resembled two ladder type ditching machines placed back to back, each completely trimming one-half the bottom and one side wall of the canal as the machine advanced. The whole assembly was supported by a steel bridge, the ends of which rested on railway trucks traveling on rails on each side of the canal. These rails were carefully set to the proper line and grade and controlled the accuracy of the trimming. The machine was driven forward as it excavated by means of power winches operating cables anchored ahead. The excavated material was carried clear of the canal by belt conveyors.

Another type of machine was developed by Jahn and Bressi Construction Company. This machine also had a heavy trussed steel frame or bridge which traveled on rails on each side of the canal trench. Instead of endless chains of digging buckets, however, it was equipped with blades similar to that of a road grader, which were lifted, lowered or tilted by an elaborate system of hydraulic and screw jacks. The machine was hauled forward and backward by a tractor in the canal trench, making a light cut on each forward run until the finished grade was reached. The excavated material was pushed to the bottom of the trench by the blades and was carried away by bucket elevators and belt conveyors.

Each of these machines operated satisfactorily and economically. Machines developed by other contractors were built on the grader principle.

Reinforcing steel for the lining was placed by hand—practically the only hand operation entering into the canal construction. The steel was laid on precast concrete blocks placed on the subgrade.

The type of canal paving machine finally adopted by all of the contractors was also pioneered by Wood and Bevanda. Stripped of operating and auxiliary mechanisms, it was neither more nor less than a giant trowel, formed of steel plates fastened to a heavy steel framework and shaped exactly to the dimensions of the finished lining. This machine traveled on the same tracks as the trimmer and was drawn by winch and cable at the rate of about one foot per minute. Two paver type concrete mixers fed by a fleet of batch trucks kept pace on the roadway alongside the canal and a gasoline driven car shuttled back and forth across the deck of the paving machine receiving concrete from the mixers and distributing it along the forward edge of the "trowel." A ribbon of completed lining flowed from under the trailing edge of the machine, requiring in general only finish steel troweling to produce the smooth, hard, water wearing surface desired. Several light wooden frames were usually drawn behind the paving machine to support the concrete finishers on this work.

# TUNNELS

(*Continued from Page* 4)

arch, and then subjecting the fresh concrete in the crown section to pressure by keeping the end of the discharge pipe well buried.

In this manner overbroken areas in the crown were filled to heights of 6 ft. or more above the forms. Staggered lines of test holes were drilled in the finished arch to test the filling of voids. Good compaction and smooth surfaces were secured by hand spading the concrete.

Concrete batching plants were located near the tunnel entrance where the weighted materials were placed, dry, in especially designed batch cars for transporting into the tunnel.

# M.W.D. Water Use Shows Big Increase In 1938 Over 1933

Based on data which is supplied annually by the various municipal water departments, information showing the 1938 water consumption in the cities of the District is now being compiled.

Although all of this information had not been assembled at the time this issue of the NEWS went to press, sufficient data was available to show an ever mounting domestic and industrial water demand in the District, and to indicate the constantly increasing population growth and economic development in the cities of the Metropolitan Water District.

Because of the fact that the period from 1933 to 1938, inclusive, was the time that major construction was in progress on the Metropolitan Aqueduct, the increase in water consumption in the cities of the District during those five years is of particular interest.

The water department records of ten M.W.D. cities, not including Los Angeles, Compton, and San Marino, show that these ten cities consumed a total of 496 million cubic feet more water during 1938 than in 1933.

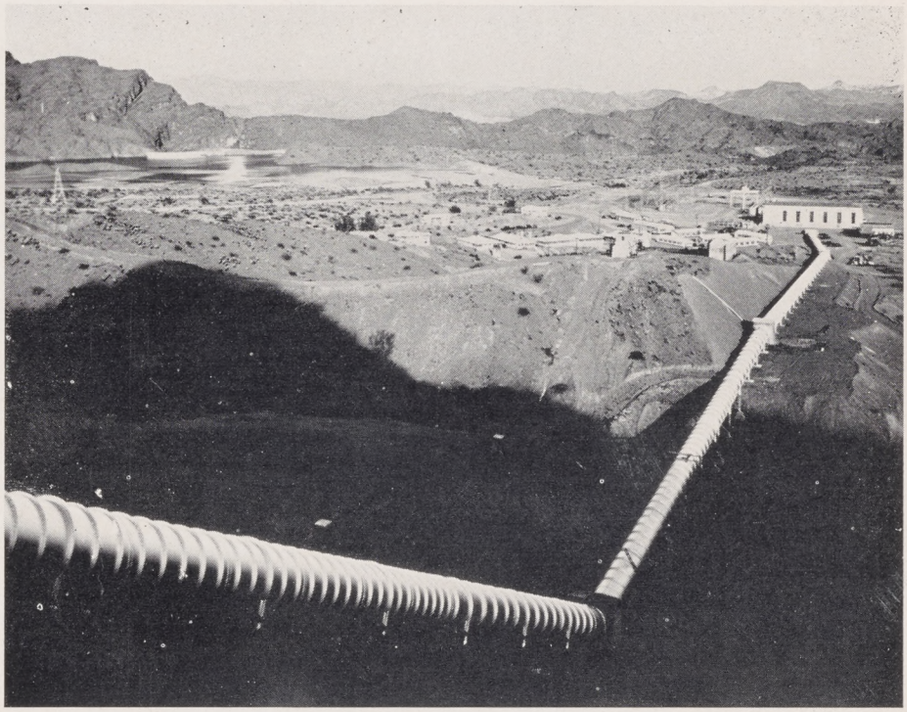
The city of Los Angeles alone reported that it used one billion two hundred twenty million cubic feet of water more in 1938 than it did in 1933.

Domestic and industrial water consumption in the city of Los Angeles found its greatest use during the month of August in 1938, when a total of ten billion two hundred seventy-one million cubic feet of water was used.

Indicating population growth that has taken place in Los Angeles during this five year period is the fact that of the total increase, 1,025,000,000 cubic feet was for domestic and industrial purposes, and 195,000,000 cubic feet was for agricultural use. The domestic water demand in Los Angeles showed a 5 per cent increase in 1938 over that of 1937, and a 14 per cent increase over the demand in 1933. The domestic and industrial demand represents 75 per cent of the total water use in the city of Los Angeles.

All of the cities in the District have shown a rapid increase in water consumption during the last five years, and a number of these indicated particularly large population increases during the year 1938. Burbank, for example, reported a gain of 1278 water services in 1938 and an increase of 26 per cent in its water consumption over that of the previous year.

As compared to water use in 1933, Long Beach showed an increase in 1938 of 10 per cent; Santa Monica, 36 per cent; Torrance, 76 per cent; Anaheim, 22 per cent; Beverly Hills, 13 per cent; Fullerton, 30 per cent; Glendale, 20 per cent; Pasadena, 15 per cent; and Santa Ana, 12 per cent.



**The Gene delivery line, pumping plant, and reservoir (upper left) as seen from the east portal of Copper Basin tunnel No.1.**

**This 16-foot diameter reinforced concrete siphon connects Copper Basin tunnels No. 1 and 2, and is located about midway between the Gene pumping plant and the Copper Basin reservoir.**

**A general view of the hundreds of past and present aqueduckers and their friends who attended the Employees Association party on February 18.**

## Big Crowd Vote Employees Party Complete Success

The party was expected to end at midnight, but the musicians were cajoled into playing an extra half hour. At 12:30 A.M. a hasty meeting of the Board of Directors of the Employees Association was called and additional money appropriated to buy music for another half hour. At 1:00 A.M. a committee of aqueduckers called on the orchestra and suavely (?) pointed out that it was cold outside and the musicians might as well stay inside where it was warm. At 1:30 A.M. the orchestra collapsed from sheer exhaustion and were carried out feet first through a booing mass of jitterbugs who didn't want to go home.

As was to be expected, the Employees Association party held at the Los Angeles Elk's Club on February 18 was a complete success. The party was a sell-out, with more than 425 people attending, and in order to get everybody in, Charlie Brandt, party chairman, was selling late comers choice under-the-table parking privileges at no reduction in cost.

The food was excellent, the entertainment far above the average, and judging by the way the crowd packed the floor, they liked the music which was served by Sam Furman and his orchestra. The fact that everyone had a good time is a fine compliment to the advance work done by the party committee, which in addition to Brandt included Dolores Sholz, Marjorie Howell, and Merrill Johnson.

One of the nicest things about the party was that so many ex-aqueduckers attended, and also the fact that every section of the aqueduct, all the way from the Colorado River to the Palos Verdes reservoir, was well represented by present aqueduckers. Julian Hinds, Assistant Chief Engineer of the District, acted as toastmaster, and managed to shout the crowd down long enough to welcome them to the party.

The program for the evening was printed in the formal manner of a set of M.W.D. Specifications. The crowd read these "specs" with interest, particularly the section that listed the dance numbers by John and Dolores. Probably the only disappointment of the evening came when it was found that the John and Dolores referred to were professionals (who did an excellent job), and not the John Binney and Dolores Sholz that the crowd was avidly waiting to see do an acrobatic waltz to swingtime.

### DISTRICT MOTION PICTURE SHOWN TO MANY GROUPS

Indicative of the general public interest in the District and the Colorado River Aqueduct is the large number of requests being received for showings of the District's latest motion picture, "The Thirteen Golden Cities".

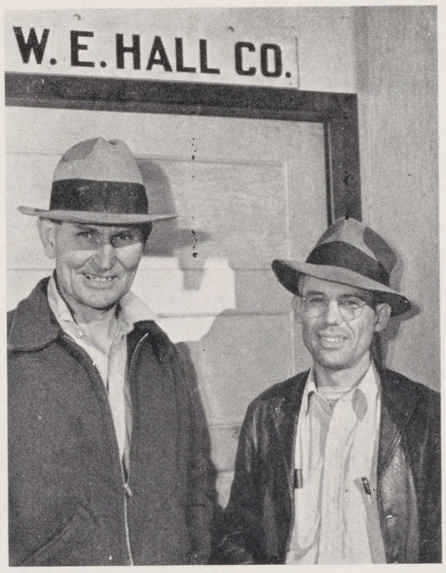
During the period January 20 to February 20, the picture was shown to 63 different groups, most of which were service clubs and other civic organizations in the cities of the M.W.D. In the course of this period as many as seven showings of the film have been made in one day. Projection of the film is handled by Vernon Glass, Walter Parker, Jack Williams, and Arthur Vetch.

### BIDS CALLED FOR ON TREATMENT PLANT EQUIPMENT

The District has called for bids, to be opened March 7, 1939, for furnishing mechanical equipment for mixing and settling basins in the Upper Feeder Water Treatment Plant which is to be located on the distribution system in the vicinity of San Dimas.

The equipment is to be provided under Specifications No. 302, which lists alternative schedules for furnishing different types of mechanical mixing and sludge removal assemblies.

# NEWS FROM FIELD AND OFFICE




**Pictured above are the chief potentates for the contractor on the construction of the Palos Verdes reservoir. They are Magnus Hjalmarson, superintendent, and Wes Irwin, engineer. Both gents are old-time aqueduckers and both have at one time been employed by the M.W.D.**

Members of the Electrical-Mechanical division are now handling reservations for speaking engagements for "Senator" W. P. Winn, who has just returned from Washington, D. C. The "Senator," who is also known as Junior Engineer Paul Winn (and who was in Washington on District business) is said to be able to discuss foreign affairs, recovery, re-armament, or the price of next year's beans, on a moment's notice. During the time that the "Senator" was staying in the capitol, President Roosevelt called at his hotel. However, the "Senator" modestly states that the real reason for the President's call was the fact that Vice-President Garner lived in the same hotel.

* * *

Transfers of District employees which have been made in recent weeks, but which have not been recorded in these columns include:

Coral Thompson, from the Purchasing Division to the Division 5 construction office.

R. P. Bushey, from the Intake & Gene plants to the Transmission Line.

H. D. Root, from the Electrical-Mechanical Division to the Design Division.

G. B. Bynan, from the Iron Mountain pumping plant to the Intake & Gene plants.

**Aqueduct Temperatures**

**January 15 to February 15, 1939**

| | Max. | Min. |
|---|---|---|
| Div. 1 | 66° | 33° |
| Div. 2 | 70° | 32° |
| Div. 3 | 72° | 30° |
| Div. 5 | 66° | 24° |

Another old-time aqueducker who has recently left the District is Fred Ingram, formerly assistant engineer in the Distribution division. Fred has been with the M. W. D. since January, 1931. He and his family left Southern California early in February to go to Norfolk, Virginia, where he will be employed as an associate engineer by the U. S. Army engineers. Unfortunately space does not permit the reproduction of the very eloquent and decorative epistle which was presented to Fred by the distributioners as a token of their esteem when he went away.

* * *

Junior Engineer H. K. "Kirby" Schlegel has been transferred from the Distribution Division to the Design Division.

A note from Potrero states that Walter Piper, chief electrician on that part of the San Jacinto tunnel job, is now the proud papa of a son, Charles James Piper, who arrived on January 11.

* * *

Charles Pankratz, who started work for the District in 1935, and who was last employed as a general foreman on the construction of the Hayfield pumping plant has accepted a position in connection with the construction of the Yuba dam near Marysville, California.

* * *

Dave Koontz, who has been in the buyer's office in the Purchasing Division since January, 1933, resigned from the District on February 18 to accept a position in the Purchasing Department of the Lockheed Aircraft Co. in Burbank, adding one more name to the flourishing ex-aqueduckers alumni association chapter now doing business at that aircraft plant.

* * *

Old-timers will be sorry to learn of the death, in Compton on February 2, of George B. Harlan, who worked for the District from 1933 to 1935 on main aqueduct construction.

**Tch—tch—tch, Mr. Leadbetter, throwing snowballs is agin the law. This picture, which shows the members of the M. W. D. polar expedition, was made in the court of the Banning headquarters on February 3. Back row, left to right: "Van" Van Wye, Fred Carleton, A. E. McKenzie, A. O. Dahlke, A. Hasle. Front, left to right: General Superintendent "Mike" Leadbetter, Winifred Guay, Coral Thompson, Marion Robertson, and Jessie Hoge.**

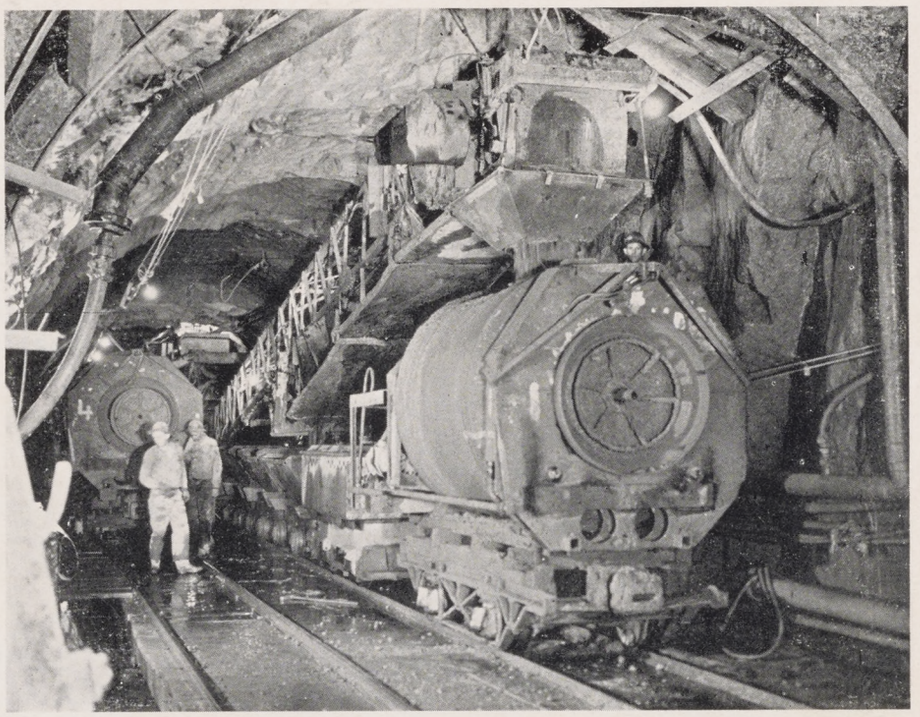
# Placing of Invert Completed In San Jacinto Tunnel

B. C. Leadbetter, General Superintendent of the San Jacinto tunnel, announced on February 4, that the placing of all concrete in the invert (floor) of that 13-mile tunnel had been completed. With this work finished, it was possible to concentrate on the placing of concrete arch lining in both the east and west sections of the tunnel.

During the week ending February 18, a total of 1517 feet of arch lining, amounting to 6,828 cubic yards of concrete, was placed east and west of the Lawrence adit. Of this amount 782 feet was placed on the Cabazon side, and 735 feet was placed on the Potrero side of the adit.

On February 18, in addition to all of the invert, 59 per cent of the arch lining has been placed, leaving 28,220 feet still to be placed. Of this total, 9,714 feet remain west of Lawrence adit, and 18,506 feet east of the adit.

Concrete work is being handled from batching plants at both the east and west portals of the tunnel. Dry batches are taken in trains to portable mixers in the tunnel, mixed, and moved up to the placing machines in portable agitators.



**Portable concrete agitator in the San Jacinto tunnel receiving a batch of fresh concrete as it comes off the conveyor belt from the underground mixer. Agitator is then pushed up tunnel by electric locomotive to placing machine.**

The buildings and other equipment at the Cabazon camp are being dismantled, and all utilities are being removed from the Lawrence adit.

**One of the principal attractions of Division 1 headquarters is its mess hall which is ably administered by the crew shown above. Back row, left to right: Paul Chavis, Chef Bill Smith, Roland Dibou. Front row, left to right: John Ketter, Clifford Hammond, and Marine Georgescu.**

# First Water Pours Into Copper Basin

(*Continued from Page* 2)

most of which were designed to check on the automatic control features of the plant. Due to their experience gained in testing the Intake plant, the crew of testing engineers handled their intricate job without a hitch.

Because of the fact that the Gene plant draws water from the Gene basin reservoir, and in order to maintain the water level in this reservoir, it was necessary to operate the Intake plant in coordination with the Gene plant—thus for the most of the time all six of the giant electric motors, with a combined capacity of 54,000 horse power were operating in unison.

On February 24, the water surface in the Copper Basin reservoir was 12 feet above the invert in the outlet works at the east portal of the Whipple Mountain tunnel. Present plans call for opening the gates in the outlet structure during the month of March at which time aqueduct water will start its first long gravity hop through the tunnel and across the desert via a series of conduits, siphons, and canals to the Iron Mountain plant, which is 69 aqueduct miles west of the Colorado River.